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3	69	(project\$3 and (display or imag\$3)).ab. and (light or laser) and (mirror or refelct\$3) and (sweep\$3 and oscillat\$3) and (axis or horizontal or horizontal) and frequenc\$3	USPAT; EPO; JPO; DERWENT; IBM_TDB	2002/08/13 11:21
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4	63	((project\$3 and imag\$3).ab. and (light or laser) and (mirror or refelct\$3) and (sweep\$3 or oscillat\$3) and (axis or horizontal or horizontal) and frequenc\$3) and ((project\$3 and (display or imag\$3)).ab. and (light or laser) and (mirror or refelct\$3) and (sweep\$3 and oscillat\$3) and (axis or horizontal or horizontal) and frequenc\$3)	USPAT; EPO; JPO; DERWENT; IBM_TDB	2002/08/13 11:27

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Optical raster-scanning displays based on surface-micromachined polysilicon mirrors

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Abstract:

We demonstrate high-resolution, raster-scanning display systems based on pairs of orthogonally scanning, surface-micromachined mirrors. The first mirror of the raster-scanning pair determines the line-scan rate of the display and is driven at its resonant frequency which is on the order of 4.7 kHz. The second mirror, driven at a frequency below its resonance and scanning orthogonally to the first mirror, determines the image refresh rate. Both mirrors have a maximum optical scanning angle of 15/spl deg/. Single-chip and two-chip scanners are demonstrated. The resolution of the single-chip display, based on average pixel size, is 102/spl times/119 pixels. The curvature of the mirror surfaces are characterized and optically compensated to achieve this resolution.

Index Terms:

[display devices](#) [optical scanners](#) [micro-optics](#) [mirrors](#) [micromachining](#) [optical raster scanning display](#) [surface micromachining](#) [polysilicon micromirror](#) [single-chip scanner](#) [two-chip scanner](#) [microoptoelectromechanical system](#) [Si](#)

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Reference list:

1. J. M. Florence, L. A. Yoder, "Display system architectures for digital micromirror device (DMD®) based projectors", *Proc. SPIE*, vol.2650, pp.193-208, 1996.

2. V. Markandey, R. J. Gove, "Digial display systems based on the digital micromirror device", *SMPTE J.*, vol.104, no.10, pp.680-685, 1995.

3. K. E. Petersen, "Micromechanical light modulator array fabricated on silicon", *Appl. Phys. Lett.*, vol.31, no.8, pp.521-523, 1977.
4. O. Solgaard, F. S. A. Sandejas, D. M. Bloom, "A deformable grating optical modulator", *Opt. Lett.*, vol.17, no.9, pp.688-690, May 1992.
5. O. Solgaard, "High-resolution silicon surface micromachined displays (invited talk)", *Tech. Dig. IEEE/LEOS IEEE/SAMS 1997 Int. Conf. Optical MEMS and their Applications (MOEMS97)*, Nara, Japan, pp.9-14, Nov. 18–21, 1997.
6. F. Pan, J. Kubby, E. Peeters, J. K. Chen, O. Vitomirov, "Design, modeling and verification of MEMS silicon torsion mirror", *Proc. SPIE*, vol.3226, pp.114-124, 1997.
7. D. L. Dickensheets, G. S. Kino, "Microfabricated biaxial electrostatic torsional scanning mirror", *Proc. SPIE*, vol.3009, pp.141-150,
8. V. R. Dhuler, M. Walters, R. Mahadevan, A. B. Cowen, K. W. Markus, "A novel two axis actuator for high speed large angular rotation", *Proc. 1997 Conf. Solid-State Sensors and Actuators (Transducers'97)*, pp.327-330,
[\[Abstract\]](#) [\[PDF Full-Text \(536KB\)\]](#)
9. M.-H. Kiang, D. A. Francis, C. J. Chang-Hasnain, O. Solgaard, K. Y. Lau, R. S. Muller, "Actuated polysilicon micromirrors for raster-scanning displays", *Proc. 1997 Int. Conf. Solid-State Sensors and Actuators (Transducers'97)*, Chicago, IL, pp.323-326, June 16–19, 1997.
[\[Abstract\]](#) [\[PDF Full-Text \(368KB\)\]](#)
10. M.-H. Kiang, O. Solgaard, R. S. Muller, K. Y. Lau, "Micromachined polysilicon microscanners for barcode readers", *IEEE Photon. Technol. Lett.*, vol.8, pp.1707-1709, Dec. 1996.
[\[Abstract\]](#) [\[PDF Full-Text \(448KB\)\]](#)
11. M.-H. Kiang, O. Solgaard, K. Y. Lau, R. S. Muller, "Electrostatic combdrive-actuated micromirrors for laser-beam scanning and positioning", *IEEE J. Microelectromechan. Syst.*, vol.7, pp.27-37, Mar. 1998.
[\[Abstract\]](#) [\[PDF Full-Text \(328KB\)\]](#)
12. K. W. Markus, D. A. Koester, A. Cowen, R. Mahadevan, V. R. Dhuler, D. Roberson, L. Smith, "MEMS infrastructure: The multi-user MEMS processes (MUMPs)", *Proc. SPIE, Micromachining and Microfabrication Process Technology*, Austin, TX, vol.2639, pp.54-63, Oct. 1995.
13. C. W. Dyck, J. H. Smith, S. L. Miller, E. M. Russick, C. L. J. Adkins, "Supercritical carbon dioxide solvent extraction from surface-micromachined micromechanical structures", *Proc. SPIE*, vol.2879, pp.225-235, 1996.
14. K. S. J. Pister, M. W. Judy, S. R. Burgett, R. S. Fearing, "Microfabricated hinges", *Sens. Actuators A*, vol.33, no.3, pp.249-256, 1992.

15. E. J. Rinalducci, "Panel on Impact of Video Viewing on Vision of Workers", *Video Displays, Work and Vision.*, Nat. Academy Press, Washington, DC, 1984.
16. W. D. Thomson, J. Saunders, "The perception of flicker on raster-scanned displays", *Human Factors*, vol.39, no.1, pp.48-66, 1997.
17. L. Beiser, R. B. Johnson, "Scanners", *Handbook of Optics*, McGraw-Hill, New York, vol.II, pp.19.1-19.57, 1995.
18. J. Hagerman, "Optimum spot size for raster-scanned monochrome CRT displays", *J. SID*, vol.1, no.3, pp.367-369, 1993.
19. P. Belland, J. P. Crenn, "Changes in the characteristics of a Gaussian beam weakly diffracted by a circular aperture", *Appl. Opt.*, vol.21, no.3, pp.522-527, Feb. 1982.
20. H. T. Yura, T. S. Rose, "Gaussian beam transfer through hard-aperture optics", *Appl. Opt.*, vol.34, no.30, pp.6826-6828, Oct. 1995.
21. P. J. Brosens, "Dynamic mirror distortions in optical scanning", *Appl. Opt.*, vol.11, no.12, pp.2987-2989, Dec. 1972.

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